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CONSERVATION *in the KLICKITAT,* USING GRASSES *and* LEGUMES

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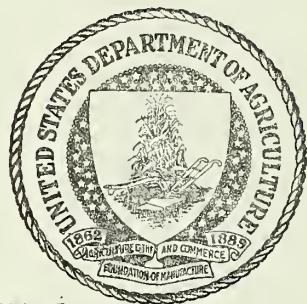
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CONSERVATION IN THE KLICKITAT, USING GRASSES AND LEGUMES

When the Klickitat Valley was first settled it had a reputation for abundant bunchgrass and fertile soils. Through the years, by repeated removal of crops and ever increasing erosion, fertility has been reduced to a very low level. Sheet erosion is serious, organic matter is low, and the soil puddles and bakes badly. More than 50 percent of the top soil has been lost over most of the valley.

Control of erosion at the present fertility level is not enough. It is necessary to rebuild the structure and physical condition of the soil with grass and grass roots. Fertility and nitrogen content of the soil must be built up with legumes. Conservation becomes more than saving what is left; it is building back toward the original high organic and fertility levels of the virgin soil. It is saving and using the water where it falls.

The agriculture of the community is changing. Farmers are turning from a wheat-summer fallow system to a market hay crop. Alfalfa hay stands are left in for many years. A rotation system using alfalfa-grass and grain is a more desirable system of conservation farming than either all grain or all hay. Grass must be planted with the alfalfa for two principal reasons: (1) To give greater protection against the loss of topsoil by erosion, and (2) to improve the structure of the soil.

To help solve the problems of building back, the Goldendale Nursery was established by the Soil Conservation Service in co-operation with the State College of Washington in 1936. It was planted on the W. F. Hornibrook farm about 4 miles south of Goldendale, Washington. It is part of a system of nurseries of the Soil Conservation Service, U. S. Department of Agriculture. Initial tests of thousands of grasses are made at the central nursery at Pullman, Washington. The most promising plants are then tested in nurseries like Goldendale. Plants are observed and measured for their conservation value and local adaptation. This local nursery was established to provide needed information for conservation farming in the Goldendale community. The results have application to adjacent areas.

Soils and Erosion

Soil and climatic conditions at this nursery are representative of the Central Klickitat Soil Conservation District, with the exceptions of the Swale Creek Flat and the Goodnoe Hills. The location of the nursery plot and the weather stations is indicated on the district map.

Most of the upland soils in the district are Goldendale loam or a very similar type. The soils were formed in place by decomposition of basalt. They vary from 2 to 6 feet in depth to bedrock. In its virgin condition the soil supported a luxuriant growth of grasses and native legumes. Pioneers reminisce of the "nigger wool"--the rich, dark brown color--and the ease of working these soils in the early days.

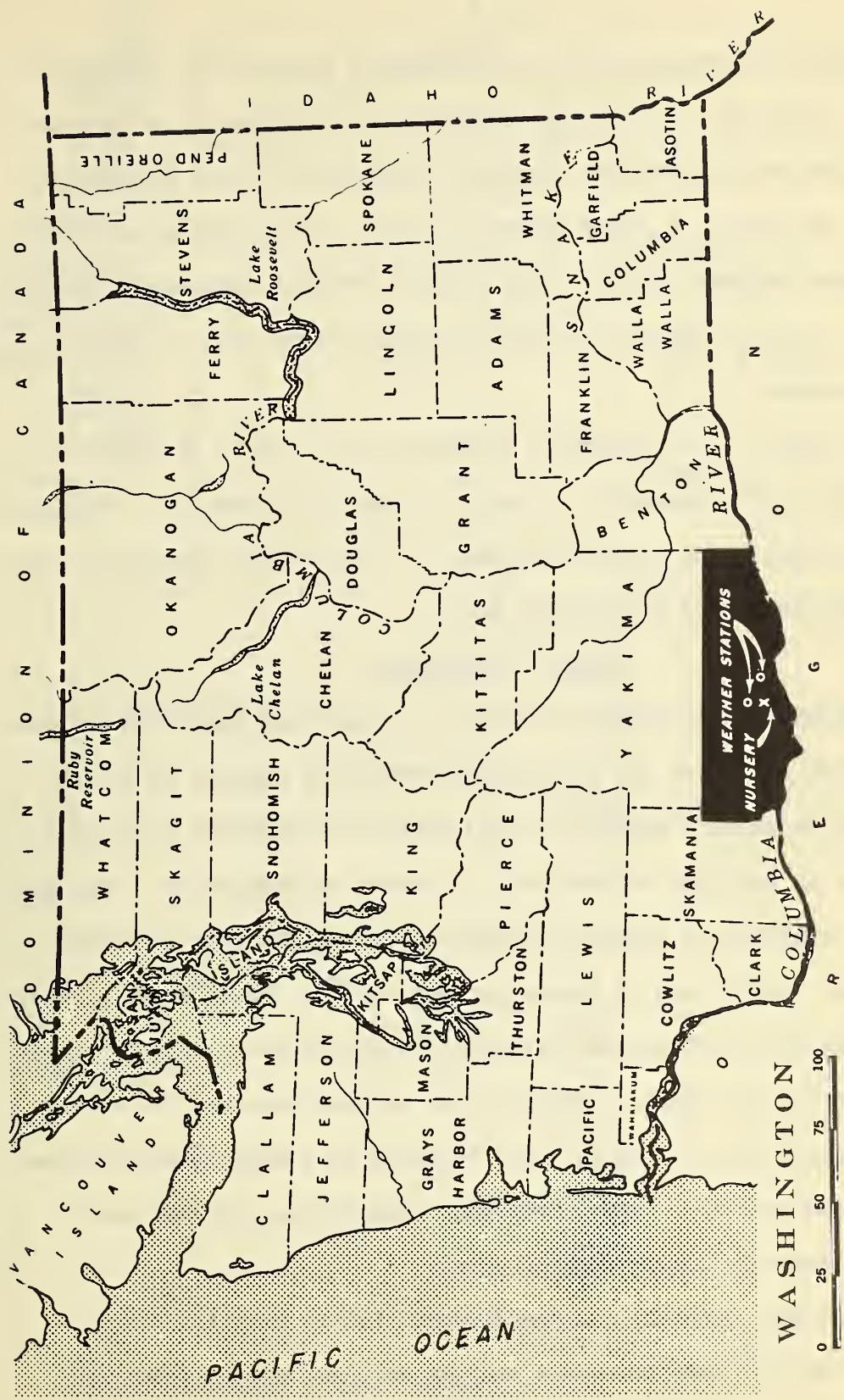


FIGURE I.—Location of the Goldendale Outlying Nursery and the 2 weather stations in the vicinity.

Recent investigations by the Washington Agricultural Experiment Stations indicate a 1.0 percent organic matter content of Goldendale loam fields which have been cropped to wheat in a fallow system for the past 65 years. A field recently plowed out of alfalfa has nearly 2.0 percent organic matter. Soil samples from the unplowed roadsides indicate that the original level of organic matter varied from 1.5 to 2.3 percent.

The soil at the nursery is Goldendale loam, 24 to 36 inches deep to bedrock. It is mapped as 6M and is capability Class II. More than half the topsoil has been eroded away. It had raised only grain since it was broken out of grass about 1885.

Climate and Erosion

Rainfall is low--about 16 inches per year--and elevation is low--about 1,600 feet--for the alfalfa-grain types of farming which the community supports. Rainfall varies within the district from about 22 inches at Hartland to less than 14 inches at Rock Creek. From year to year, rainfall is erratic, ranging at Goldendale from less than 12 inches to more than 24 inches per year within the 10 years of this study. Monthly distribution of precipitation is very erratic, especially during the winter. Rainfall has varied from none in January 1947 to quantities exceeding 5 and 6 inches in a single month between October and February. These extremely high monthly intensities of rainfall occur in about 1 out of 3 years.

The annual rainfall and the distribution by months for the period 1936-1950 for Goldendale and the Ferguson Ranch, short distances from the nursery, are shown in Figure 2.

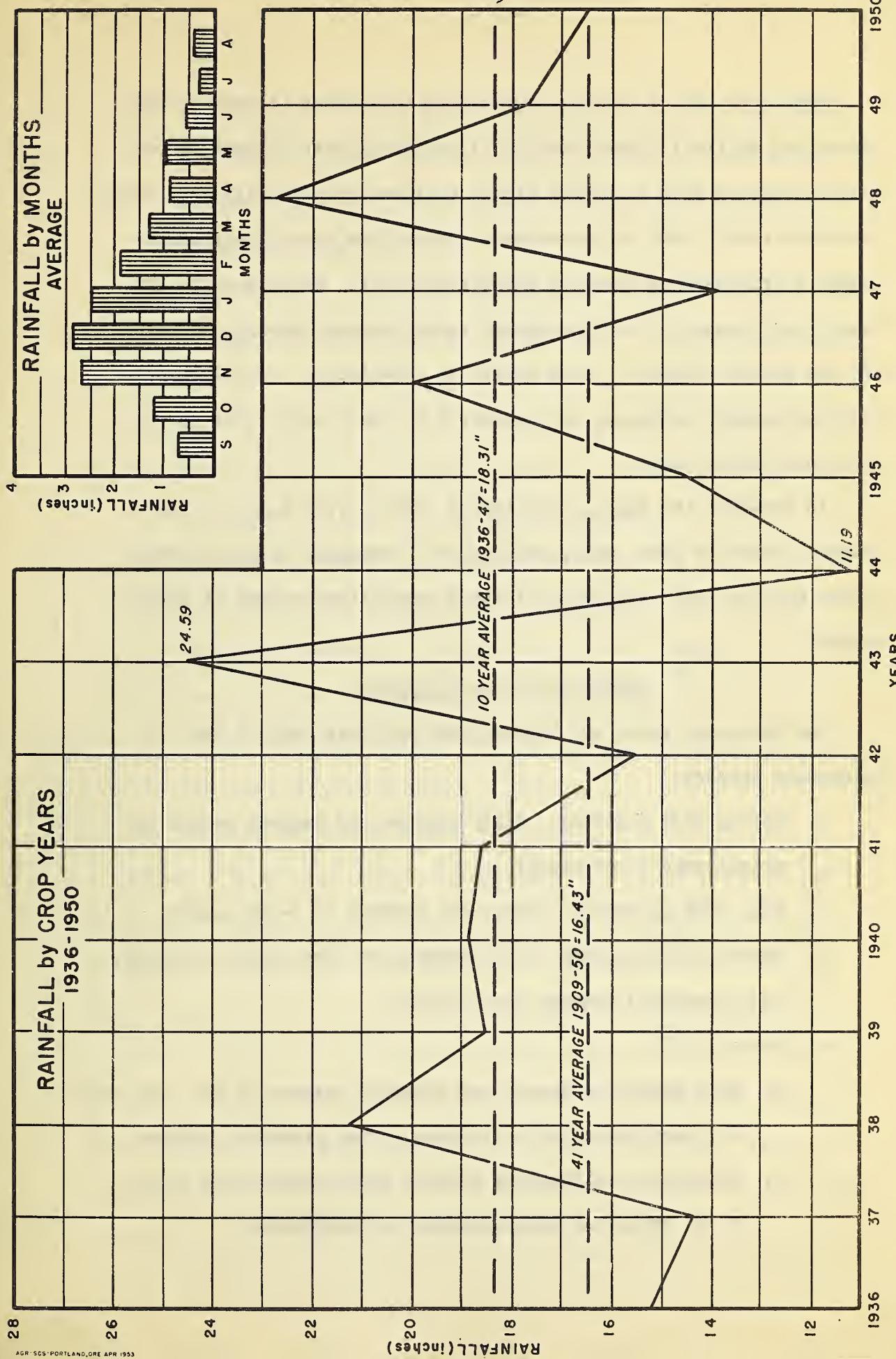


FIGURE 2.-Distribution of rainfall at Goldendale, Washington.

Soil must have a cover of vegetation to protect it from erosion during the critical winter period. An added climatic hazard is the accumulation of snow on frozen ground followed by warm rain or a warm "chinook" wind. Most of the erosion occurs from these heavy winter rains or from melting snows on unprotected soil. Shallow soils and "scab rock" areas do not have enough water-holding capacity to hold all the winter rainfall. Some runoff is inevitable. Diversion systems and grassed waterways are necessary to carry this water safely over lower lying lands.

In one-half the years, less than 1 inch of rain falls in the 3-month period of June, July, and August. Perennial soil-protecting plants must be able to survive or evade these long periods of summer drought.

Legume and Grass Plantings

The following grass and legume plantings were made at the Goldendale nursery:

1. Spring 1936 planting. Sixty grasses and legumes seeded in triplicated 3-row blocks.
2. Fall 1936 planting. Fifty-four grasses in 3-row blocks.
3. Spring 1937 planting. One hundred and five native, foreign, and introduced grasses and legumes.
4. Spring 1938.
 - a. Rows seeded to annual and biennial legumes in the 1936 nursery were replanted to legumes or new perennial grasses.
 - b. Fourteen alfalfa-grass mixture plots were seeded on the H. G. McPherson farm northwest of Goldendale.

5. Spring 1948. A cooperative grass-alfalfa variety plot nursery was established on the Harold Hill farm. This nursery was supplemented by several fertilizer trials on alfalfa on adjacent farms, 1947-1949.

All the plantings listed above, except the plots, were made with 24-inch row spacings and cultivated until 1940. The rows were plowed out in 1949.

Each of the species and strains in these plantings was evaluated for conservation use on the following bases:

1. Protection of soil surface against erosion.
2. Ability to improve soil structure.
3. Ability to grow with alfalfa in mixtures.
4. Ability to maintain a stand for at least 6 years.
5. Production of forage.
6. Ability to compete with weeds.
7. The ease of establishing a stand.
8. Ability to produce a good seed crop.

Table 1 shows the amount of ground cover and feed produced from the nursery planted in the spring of 1936. Thirty-two grasses and 28 legumes were planted. The same kind of information for the fall 1936 nursery is shown in Table 2.¹ This nursery had 51 grasses and 4 legumes in it. For each of these two nurseries data were taken for at least 4 years. From this information it was possible to determine which grasses and legumes were best for use in this area. Also, it was possible to divide both grasses and legumes into groups according to the way they could best be used to protect and improve the soil.

¹Yields in Tables 1 and 2 are based on average of 3 replications.

The groups were: (1) Grasses for mixture with alfalfa including (a) long-lived bunchgrasses, (b) understory grasses, (c) sodgrasses, and (d) those grasses that provide ground cover and improve the soil but do not show in the harvest hay; (2) those that can be used in sweet-clover-grass mixtures; (3) those that will have specialized uses; and (4) those that were not believed to have any use in this area.

Two other nursery row plantings were made, one in 1937 and one in 1938, but these were failures because of beating rains that crusted the surface. Only 9 out of 105 accessions produced stands better than 50 percent under these conditions. No tables are included.

The alfalfa-grass plots established in 1938 on the H. G. McPherson farm northwest of Goldendale were harvested for yield in 1941 and 1942. The average annual production was 1-1/2 tons of hay per acre with 16 percent grass. The production data and percentage grass are summarized in Appendix Table 3. These data offer proof that crested wheatgrass, beardless wheatgrass, or big bluegrass will maintain 15 to 20 percent grass in an alfalfa mixture.

The 1948 plots included the following grasses, each with Ladak alfalfa: hard fescue; sheep fescue; Canada bluegrass; Sherman big bluegrass; and Whitmar, crested, intermediate, and pubescent wheatgrass. The seeding season was very favorable, and excellent stands of all mixtures were obtained. Production data were taken in 1949 and 1950. Hay yields again averaged 1-1/2 tons per acre. Grass percentages ranged from a trace to 50 percent of the mixture. Sheep and hard fescue gave excellent ground cover but were hardly present in the hay. Intermediate and pubescent wheat mixtures with alfalfa contained between 50 and

60 percent grass. Whitmar wheatgrass, Sherman big bluegrass, sheep fescue, and crested wheatgrass were the only grasses to remain productive through seasons of normal to below normal rainfall.

Many field mixture seedings were made on farms during 1936 to 1938 using alfalfa, smooth brome, slender wheatgrass, and tall oatgrass. These grasses gradually disappeared so that in a few years the fields had the appearance of pure stands of alfalfa. It was soon realized that these grasses were not adapted, but that crested wheatgrass and Sherman big bluegrass were maintaining stands in alfalfa mixtures. Stands of the latter group have maintained their balance with alfalfa over a period of 10 years. Cheatgrass invasion of stands is prevented by a vigorous, early growing grass in the mixtures.

Grasses for Mixture with Alfalfa

Long-lived bunchgrasses. Grasses for mixture with alfalfa must be long-lived and maintain production. The six best grasses are listed in the following table.

Production in pounds per acre from two plantings of long-lived bunchgrasses made at Goldendale in 1936.

Species	Spring Planting	Fall Planting	Average
	5-year total 1937-41	4-year total 1938-41	per year
Sherman big bluegrass	5943*	6714	1406
Beardless wheatgrass	5324	5415	1193
Crested wheatgrass	5955	4611	1174
Bluebunch wheatgrass	4890	4332	1025
Orchardgrass	3508	4081	843
Tall oatgrass	4005	2814	758

*Four-year total.

Sherman big bluegrass and Whitmar wheatgrass are varieties of grass from the native vegetation of the Northwest which were tested and selected by Soil Conservation Service Nurseries and cooperating experiment stations. Certified seed of both is now commercially available. For mixture with alfalfa, either one of these grasses or crested wheatgrass is most desirable. Field plantings and field trials made on farms in the community bear this out. After 10 years, field plantings of alfalfa with any one of these three grasses are still producing good crops of alfalfa-grass mixture. The stands are good and provide an excellent ground cover.

Crested wheatgrass, Sherman big bluegrass, and Whitmar wheatgrass all reach the hay stage of maturity at about the same time as alfalfa. A short description of each grass follows.

Sherman big bluegrass is a native bunch-type bluegrass. It is outstanding for its early succulent spring growth, drought resistance, high yield, extensive root system, and compatibility in alfalfa-grass mixtures used for hay. It should be planted in alternate rows with alfalfa. Establishment is difficult and should be attempted only by those who have had previous experience with other grasses. Seedings should be made very early and very shallow on a clean, very firm seedbed. Use depth regulators. Grazing should not be permitted during the first two years of the life of this grass.

Crested wheatgrass is a drought and cold resistant grass which has been in common use in dryland areas for many years. One of the first plantings of crested wheatgrass in Goldendale was made by Harry Ferguson in the early 1920's. Seed is available and stands are easily established with alfalfa. Alfalfa-crested wheatgrass makes a palatable hay mixture, as demonstrated by feeding trials at Union, Oregon.

Whitmar wheatgrass is a leafy, native perennial dryland bunch-grass. It is slower to develop than crested wheatgrass but, after the first year, provides good ground cover. It produces a large amount of roots to improve soil structure and, when grown with alfalfa, an excellent hay is produced. It has few or no beards (awns).

Understory grasses. The vernal dominants (plants which make their growth in the early part of the season) and the fine-leaved fescues should be considered for planting with alfalfa. One of these grasses may be used to provide winter ground cover and root production to improve the physical condition of depleted soils.

Production from two plantings of grasses at Goldendale, Washington.

Species	Spring Planting	Fall Planting	Average
	4-year total	4-year total	per year
	1938-41	1938-41	

Vernal Dominants:

Sherman big bluegrass	5943	6714	1582
Nevada bluegrass	Not planted	2496	624
Sandberg bluegrass	940 (3 years)	1400	337
Bulbous bluegrass	530 (3 years)	850	197

Fine-leaved Fescues:

Chewings fescue	2824	3496	790
Idaho fescue	2655	2720	672
Sheep fescue	2619	1621	530

Sherman big bluegrass appears in both this group and the long-lived perennial bunchgrasses. In mixtures with alfalfa it contributes from 10 to 30 percent to the yield of the hay.

Bulbous bluegrass matures too early and makes very little root growth. It is especially undesirable in market hay because of its bleached appearance. It has a use for seeding on depleted range and pasture land that cannot be cultivated. Nevada bluegrass and Sandberg bluegrass have been erratic and seed is not commercially available.

In the fine-leaved fescue group, sheep fescue makes excellent ground cover and tremendous root growth and establishes rapidly from fall seeding into a young alfalfa stand. Most of the growth is basal

and contributes little to the harvested forage. It may be used in fields intended for market hay if grass content is objectionable. Seed is commercially available. Chewings fescue is less drought resistant than sheep fescue, and Idaho fescue is more difficult and slow to establish.

Sod Grass Performance. The sod grasses which might be used with alfalfa are listed below. Neither their forage yields nor their root development as measured at other nurseries compares with the long-lived bunchgrasses. However, they may be used for waterway and gully plantings. Smooth brome planted with alfalfa has proved short-lived on upland Goldendale loam.

Production from two plantings of sod-forming grasses at Goldendale in 1936.

Species	Spring Planting 5-year total 1937-41	Fall Planting 4-year total 1938-41	Average per year
Western wheatgrass	3768	3441	801
Smooth brome	3846	2405	695
Beardless wild-rye	2560	2980	616

Pubescent wheatgrass
Intermediate wheatgrass

These grasses were planted in a later nursery and in plots where yields were taken. Pubescent wheatgrass is the only sod grass recommended for mixture with alfalfa.

Alfalfa Varieties. Six alfalfa varieties were planted in 1936, and production was measured for 5 crop years. Average yields are given below and production by years is given in Table 2. Legumes other than alfalfa and sweetclover were tested, but yields were so low they were eliminated from further consideration.

<u>Variety</u>	<u>1937-41 Average 5-year yield</u>
Ladak	2516
Hardistan	2145
Grimm	2466
South Dakota Number 12	2080
Arizona common	2180
Washington common	2470

Differences because of variety were small, but Ladak, Grimm, and Washington common (local Goldendale-grown seed) were the best producers. In an alfalfa variety trial established on the Harold Hill farm in 1948, Ladak, Grimm, and Ranger were the highest producing varieties. A hardy northern alfalfa variety such as Ladak should be used.

In 1947 complete fertilizer trials were put on old alfalfa stands on the Linden, Trumbo, and Hill farms. The fertilizer trials were conducted in cooperation with Tom Jackson, in charge of outlying testing for the Washington Agricultural Experiment Stations, Agronomy Division. Trials included N, P, K, alone and in various combinations with boron, sulphur, manure, and gypsum. Trials were added to the Hornibrook farm in 1948. Results of all trials, 1947 through 1949, showed responses only to sulphur applied as such or in the form of gypsum. Increased hay yield ranged from 400 to 1,200 pounds per acre. On the basis of these trials, an

application of 200 pounds per acre of 18 percent sulphur gypsum is recommended every 2 years, or 200 pounds gypsum with 40 pounds sulphur every 4 years. Borax should be applied at 20 pounds per acre where deficiency symptoms are present.

The only other response was increased grass growth where nitrogen was applied. Yields were increased about 400 pounds per acre by stimulating the growth of bulbous bluegrass.

The very slow establishment of new seedings on most fields indicates a generally low organic matter level. Complete fertilizer trials were established prior to new alfalfa seedings. There was no response except where a heavy application of manure was plowed under with the wheat stubble the previous fall.

For successful establishment, new alfalfa-grass seedings must be established without a companion crop on land plowed the previous fall and worked to a firm, solid seedbed.

Recommended alfalfa-grass mixtures. Use crested wheatgrass, Sherman big bluegrass, or Whitmar wheatgrass in mixture with alfalfa. Pubescent wheatgrass, intermediate wheatgrass, and sheep fescue are promising grasses for mixture with alfalfa and may be used in field trials. Recommended mixtures and seeding rates are:

	<u>Pounds per acre</u>
1. Ladak or local alfalfa Crested wheatgrass	5 6
2. Ladak or local alfalfa Sherman big bluegrass	5 5
3. Ladak or local alfalfa Whitmar wheatgrass	5 8

Grasses for Use with Sweetclover

This group includes those grasses which establish quickly, produce a high yield the second year, and then decline sharply in yield or die out. Some of the grasses in this group are adapted for use with sweetclover for either pasture or green manure the second year or with alfalfa in short rotations. The data for this group are summarized below.

Production in pounds per acre from two plantings of rapid-developing grasses made at Goldendale in 1936.

Species	Spring Planting	Fall Planting	Average
	2-year total 1936-37	2-year total 1937-38	per year
Mountain brome	3258	2728	1497
Blue wild-rye	3008	2952	1490
Canada wild-rye	3495	2159	1414
Slender wheatgrass	3020	1931	1238
Tall oatgrass	1934	1714	912
Timothy	1605	Not planted	802

Primar slender wheatgrass is a new, early maturing, leafy, disease-resistant, rapid-developing grass. It is specifically adapted for use in sweetclover-grass mixtures. In comparison with other slender wheatgrass strains, it is earlier in spring recovery, more productive in growth, and has coarser, more abundant leaves and stems. It is compatible with and has a growth rate corresponding to that of sweetclover. The slender wheatgrass used in these trials is a strain much inferior to the more recently developed Primar.

Bromar is an improved strain of mountain bromegrass that is particularly well suited for use with sweetclover for pasture and green manure.

Sweetclover Varieties. The relative merits of eight sweetclover varieties were partially determined. Madrid, Spanish, and common yellow were the most productive and appear to be best adapted both for pasture and green manure. Subsequent seed plots and field trials have shown that it is possible to grow sweetclover seed in the Goldendale area. Madrid sweetclover is the only recommended improved variety available in quantity for conservation seedings.

Field planting trials indicate that the wild-rye grasses are not as well adapted as Primar or Bromar for planting with sweetclover.

Recommended mixtures for sweetclover-grass conservation plantings are:

	<u>Pounds</u> <u>per acre</u>
1. Madrid sweetclover	5
Primar slender wheatgrass	8
<u>or</u>	
2. Madrid sweetclover	5
Bromar mountain brome	10

Summary

1. One hundred and ninety-nine species and strains were tested in nursery rows for adaptation, production, and conservation value.
2. The best grasses for use with sweetclover are Primar slender wheatgrass or Bromar mountain brome.
3. The best adapted grasses for use with alfalfa for hay, erosion control, and soil building are crested wheatgrass, Sherman big bluegrass, or Whitmar wheatgrass. Sheep fescue is a valuable root-producing and erosion-control grass for use with alfalfa.
4. Pubescent wheatgrass is the most drought resistant, sod-forming grass for use with alfalfa.
5. Recommended mixtures:

	<u>Pounds per acre</u>
Alfalfa-grass*	
Ladak alfalfa	5
One of the following:	
Crested wheatgrass	6
Sherman big bluegrass	4
Whitmar wheatgrass	8
For erosion control in dry gullies:	
Sheep fescue	5
Pubescent wheatgrass**	5
Sweetclover-grass	
Madrid sweetclover	5
Bromar mountain brome	10
<u>or</u>	
Primar slender wheatgrass	8

*On deep soils and on the better sites alfalfa and intermediate wheatgrass can be used.

**The variety of pubescent wheatgrass that has been released in Washington and for which seed is available is Topar.



The Goldendale nursery established in 1936 on the
W. F. Hornibrook farm four miles south of Goldendale,
Washington. May 1940 V. B. Hawk 40-68



Beardless wheatgrass in the foreground was superior
to crested wheatgrass in the 1936 nursery plantings.
May 1940 V. B. Hawk 40-66



Alfalfa-grass plots seeded in the spring of 1938 on the H. G. McPherson farm northwest of Goldendale. Sherman big bluegrass is most prominent in this picture.

May 1941 V. B. Hawk 41-63



A close-up of a mixture which contained effective amounts of Sherman big bluegrass, beardless wheat, and Idaho fescue. These grasses all gave excellent ground cover.

May 1941 V. B. Hawk 41-62

Table 1. Stand and yield of vegetative cover, 1936 - 1941, of soil conserving plants which were seeded at Goldendale, Washington, in the spring of 1936.

Row No.	Species	Acc. No.	P-	Stand	Yield	5-Yr. Total	Av. Yield 1937-41										
1	Tall meadow oatgrass	3052	83	400	93	1534	92	1048	95	613	93	400	50	410	4005	801	
2	Orchardgrass	3135	97	179	90	862	85	1239	97	447	93	430	85	530	3508	701	
3	Beardless wheatgrass	2617	78	102	75	1212	82	1552	75	970	88	810	93	780	5324	1065	
4	Bluebunch wheatgrass	2719	63	121	72	934	80	1556	70	860	88	760	92	780	4890	978	
5	Crested wheatgrass	3137	99	*267	100	2420	95	1325	88	840	95	820	100	550	5955	1191	
6	Fairway crested wheatgrass	3171	85	272	92	1881	90	1107	83	663	93	620	97	480	4751	950	
7	Slender wheatgrass	3138	96	553	95	2467	93	971	Good	—	90	430	70	150	4018		
8	Western wheatgrass	2787	70	34	82	779	100	1029	Good	—	100	1380	100	580	3768		
9	Mountain brome	2133	100	646	100	2612	100	1751	100	470	98	460	85	530	5823		
10	Smooth brome	3053	93	159	95	2188	93	1003	Good	—	100	335	97	320	3846		
11	Canada wild-rye	2623	98	587	98	2908	97	1202	80	547	93	580	82	280	5517	1103	
12	Beardless wild-rye	2599	2	—	4	81	57	889	45	650	60	500	90	440	2560	512	
13	Blue wild-rye	2586	87	446	83	2562	82	1438	78	620	90	540	93	370	5530	1106	
14	Hairyscale Colorado wild-rye	3217	15	—	7	94	38	712	23	497	7	—	10	240	1543		
15	Reed canarygrass	3140	68	281	67	1469	78	1229	55	497	60	220	67	250	3665		
16	Superior reed canarygrass	2368	37	107	17	1068	55	1447	27	803	42	900	50	400	4618	923	
17	Perennial ryegrass	3162	100	998	97	1215	90	939	Poor	70	Dead	2224					
18	Timothy	3164	67	239	57	1366	85	1547	65	707	82	385	80	470	4475	895	
19	Meadow fescue	3144	95	291	100	1638	93	1438	75	507	90	240	97	450	4273	855	
20	Meadow fescue	3161	100	1495	95	1048	80	473	93	240	97	500			3756	751	

Table 1. Continued

Row No.	Species	Acc. No. P-	1936		1937		1938		1939		1940		1941		5-Yr. Av. Yield 1937-41		
			Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield	Stand	Yield			
21	Idaho fescue	2717	0	---(1)	13	---	23	122	32	873	33	600	50	1060	2655	664(2)	
22	Sheep fescue	3167	0	---(1)	27	---	63	476	83	923	58	480	60	740	2619	655(2)	
23	Chewings fescue	3150	8	---(1)	95	---	88	1211	93	703	88	300	93	610	2824	706(2)	
24	Sherman big bluegrass	2716	1	---(1)	95	---	97	2790	100	1393	97	1000	98	760	5943	1486(2)	
25	Nevada bluegrass	2579	1	---(1)	92	---	90	1937	100	1030	98	590	88	530	4087	1022(2)	
26	Canada bluegrass	3169	0	---(1)	5	---											
27	Canby bluegrass	3201	0	---(1)	85	---											
28	Sandberg bluegrass	2731	0	---(1)	72	---											
29	Bulbous bluegrass	2788	1	---(1)	33	---											
30	Prairie junegrass	2648	0	---(1)	77	---	50	183	92	530	82	210	60	460	1383	361(2)	
31	Sand dropseed	2746	0	X	50	X	Discarded										
32	Indian ricegrass	2683	0	Reseed	60	X	37	259	Poor	---	25	---	32	310	569		
33	Ladak alfalfa	3051	100	325	97	1323	100	4092	90	1787	98	3440	100	2340	12582	2516	
34	Hardistan alfalfa	3062	100	238	95	1274	82	3030	80	1383	87	3380	93	1660	10727	2145	
35	Grimm alfalfa	3143	100	335	98	2018	83	3493	83	1630	93	3310	92	1880	12331	2466	
36	So. Dakota 12 alfalfa	3160	100	436	98	1348	92	2994	92	1567	97	2880	100	1610	10399	2080	
37	Arizona common alfalfa	3170	100	558	95	1549	98	3366	93	1477	97	2940	97	1570	10902	2180	
38	Washington common alfalfa	3228	100	509	100	1664	100	3902	97	1873	98	3260	100	1650	12349	2470	
39	Sainfoin	2808	92	111	82	1151	87	708	30	240	13	190	8	180	2469	494	
40	Spanish sweetclover	2825	100	708	97	4393	20	1034)	1937 Spring Planting							

Table 1. Continued

- (1) Reseeded in fall of 1936.
- (2) Four-year averages.
- (3) Three-year averages.

Table 2. Stand and yield of vegetative cover, 1937-1941, of soil conserving plants which were seeded at Goldendale, Washington, in the fall of 1936.

Row No.	Species	Acc. No. P-	1937		1938		1939		1940		1941		4-Yr. Total	Average 1938-41
			Stand	Yield										
1	Smooth brome	3053	100	579	100	1375	90	500	100	200	100	330	2405	601
2	Mountain brome	2133	90	537	100	2191	100	1070	90	530	80	570	4361	1090
3	Orchardgrass	3135												
4	Alta fescue	2827	100	333	100	1810	100	880	100	540	100	410	4081	1020
5	Meadow fescue	3144	85	246	95	1293	95	500	90	150	25	150	3640	910
6	Sheep fescue	3167	25	30	50	670	50	240	75	480	1621	405		
7	Idaho fescue	2717	85	80	150	1400	80	630	90	540	2720	680		
8	Idaho fescue	2580	75	70	259	80	1210	70	440	80	730	2639	660	
9	Chewings fescue	3361	90	95	776	100	1540	100	530	100	650	3496	874	
10	Nevada bluegrass	2754	100	85	585	90	1020	85	780	90	460	2845	711	
11	Sherman big bluegrass	2716	90	264	90	2600	100	2000	100	1010	95	840	6450	1612
12	Big bluegrass	2579	85	210	90	1511	90	1320	90	690	90	540	4061	1015
13	Nevada bluegrass	2646	100	95	885	100	750	100	560	100	300	2495	624	
14	Canada bluegrass	3169	50	80	925	60	1070	80	490	90	520	3005	851	
15	Skyline bluegrass	2743	75	90	610	90	Poor	Poor	75	680	1290			
16	Pine bluegrass	2588	100	100	750	90	Poor	Poor	100	300	1050			
17	Sandberg bluegrass	2731	100	100	880	90	Poor	Poor	100	520	1400			
18	Sandberg bluegrass	2714	100	90	610	90	Poor	Poor	100	270	880			
19	Canby bluegrass	3201	100	100	610	90	Poor	Poor	100	380	990			
20	Bulbous bluegrass	2788	100	100	690	100	Poor	Poor	80	160	850			
21	Crested wheatgrass	3137	100	444	95	1797	95	1010	100	800	100	560	4167	1042
22	Crested wheatgrass	3171	100	525	95	1470	95	730	100	690	100	580	3470	867
23	Siberian wheatgrass	22	75	225	60	817	60	1050	75	670	80	670	3207	802
24	Slender wheatgrass	3138	100	951	95	980	0	90	410	75	190	1580	395	
25	Beardless wheatgrass	2617	100	369	1456	85	1480	90	480	90	1130	5046	1262	

Table 2. Continued

Row No.	Species	Acc. No. P-	1937		1938		1939		1940		1941		4-Yr. Total	Average 1938-41
			Stand	Yield										
26	Bardless wheatgrass	2792	100	348	80	1320	70	1610	85	940	90	880	4750	1188
27	Bluebunch wheatgrass	2719	100	183	95	1239	85	1060	100	780	100	1070	4149	1037
28	Bluebunch wheatgrass	2615	100	357	90	1633	90	1220	95	990	100	940	4783	1196
29	Western wheatgrass	2787	90	108	85	681	85	1140	100	970	100	650	3441	860
30	Western wheatgrass	3066	90	195	65	517	70	1020	80	760	100	520	2817	704
31	Giant wild-rye	3335	100	162	75	544	70	670	80	610	90	460	2284	571
32	Canada wild-rye	2623	100	825	90	1334	85	820	90	460	50	220	2834	709
33	Blue wild-rye	2886	100	516	95	2436	80	880	100	630	95	440	4986	1246
34	Beardless wild-rye	2599	75	117	60	490	70	640	90	1160	100	690	2980	745
35	Beardless wild-rye	3393	75	90	40	191	20	290	50	420	80	290	1191	298
36	Meadow barley	2603	100	471	100	1375	95	480	95	40	25	140	2035	508
37	Bearded wheatgrass	1806	100	411	95	2300	75	880	75	220	25	160	3560	890
38	Big squirreltail	3360	50	57	70	1021	90	1220	75	1170	75	480	3891	973
39	Indian ricegrass	2683	25	6	5	Poor	10	110	5	80	196	—	—	—
40	Indian ricegrass	2373	50	18	20	163	15	240	10	120	10	160	683	—
41	Lemmon needlegrass	4707	25	440	75	800	140	75	800	1240	—	—	(1)	—
42	Thurber needlegrass	4905	10	50	25	330	50	100	5	380	380	—	(1)	—
43	Needleandthread grass	3084	95	105	20	340	10	220	10	220	1232	308	342	342
44	Needleandthread grass	3356	90	51	45	721	25	750	75	730	80	420	1370	655
45	Green needlegrass	3085	100	159	45	721	25	750	75	730	80	420	2621	655
46	Sleepygrass	3211	75	517	40	340	25	440	10	100	5	110	1167	292
47	Williams needlegrass	2636	90	186	65	558	15	420	25	410	50	300	1688	422
48	Letterman needlegrass	2738	90	90	65	286	25	350	75	370	70	190	1196	299
49	Prairie junegrass	3078	60	—	10	Poor	5	Poor	10	190	190	—	—	—
50	Tall meadow oatgrass	3052	80	369	70	1375	85	500	50	270	25	300	2445	611

Table 2. Continued

Row No.	Species	Acc. No. P-	1937		1938		1939		1940		1941		4-Yr. Total	Average 1938-41
			Stand	Yield										
51	Alfalfa (Ladak)	3051	100	513			Good	90	1060	90	2830	4403		
52	Alfalfa (Arizona)	3170	10	36			Poor	10	1200	10	1280	2516		
53	Tree lupine	1775	0				Poor	1	Poor	Dead			---(2)	
54	Bighead clover	4474	0				Poor	20	Poor	50	50	50	---(2)	
55	<i>S. cereale</i> X <i>S. montanum</i>	5701					Good	1780	10	100	Dead	1880		---(2)
56	<i>S. cereale</i> X <i>S. montanum</i>	4560					Good	1550	5	55	Dead	1605		---(2)
57	<i>S. cereale</i> X <i>S. montanum</i>	4560					Poor	300	2	0	Dead	300		---(1)

(1) Planted in the fall of 1937.
(2) Planted in the spring of 1938.

Table 3. Yield in pounds per acre of alfalfa-grass mixtures--McPherson farm near Goldendale, Washington.
Planted April 27, 1938.

Plot No.	Components of Mixture	1939		1940 (1)		1941		1942		2-Yr. Total		Average % Grass
		Stand	Yield	Stand	Yield	% Grass	Stand	Yield	% Grass	Total	Average	
1 - 8	Crested wheatgrass Bulbous bluegrass Alfalfa	F		F		G	P		G			
		P	700	G	2910	16	P	3115	17	6025	3013	16-1/2
2 - 9	Whitmar wheatgrass Sandberg bluegrass Alfalfa	E		V.P.		G	P		G			
		F	720	G	2810	16	G	3260	13	6070	3035	14-1/2
3 - 10	Crested wheatgrass Smooth brome Alfalfa	E		F		G	P		F			
		F	600	G	2610	13	G	3120	17	5730	2865	15
4 - 11	Crested wheatgrass Western wheatgrass Alfalfa	E		F		G	P		F			
		F	700	G	2990	12	G	3240	15	6230	3115	13-1/2
5 - 12	Whitmar wheatgrass Western wheatgrass Alfalfa	G		F		G	P		G			
		F	690	G	2720	16	G	3320	15	6040	3020	15-1/2
6 - 13	Crested wheatgrass Sherman big bluegrass Idaho fescue Alfalfa	G		G		G	F		F			
		F	720	G	3220	18	G	3220	25	6440	3220	21-1/2
7 - 14	Whitmar wheatgrass Sherman big bluegrass Idaho fescue Alfalfa	G		F		G	G		G			
		F	855	G	3020	22	G	3060	21	6080	3040	21-1/2

(1) No yields taken in 1940.

Table 4. Accessions tested at Goldendale Nursery and discarded as not suitable for conservation use or forage.

Species	Acc. No. P-	Reason for discard
Tall meadow oatgrass	3052	Not sufficiently drouth hardy and
Orchardgrass	3135	too short-lived for use with alfalfa.
Smooth brome	3053	
Meadow fescue	3144, 3161	
Creeping red fescue	3150	
Perennial ryegrass	3162	
Timothy	3164	
Alta fescue	2877	
Western wheatgrass	2787, 3066	Slow to establish, low production on
Beardless wild-rye	2599, 3393	upland soils.
Nevada bluegrass	2754, 2646	Not as good as Sherman big bluegrass.
Sandberg bluegrass	2731, 2714	
Canby bluegrass	3201	
June grass	2648	
Bulbous bluegrass	2788	Suitable for use on range land but undesirable in hay.
Canada wild-rye	2623	
Blue wild-rye	2586	Not as good as Bromar mountain brome
Bulbous barley	305	or Primar slender wheatgrass for use with sweetclover.
Bluebunch wheatgrass	2719, 2615	Not as good as beardless wheatgrass.
Fairway crested wheatgrass	3171	Not as good as standard crested wheatgrass.
Sand dropseed	2746	Not adapted.
Indian ricegrass	2683	
Meadow barley	2603	
Idaho fescue	2717	Slow to establish; not as good as sheep fescue.
Needlegrasses	--	Not as good as other grasses.
Alsike clover	3146	Not as good as sweetclover or alfalfa.
Red clover	3165	
Vetches		
Field peas		
Sainfoin	2808	

Table 5. Common names, scientific names, and accession numbers of species referred to in the text and tables.

Common Name	Scientific Name	Accession Number and Variety
Alfalfa	Medicago sativa	P- 3051 Ladak 3062 Hardistan 3143 Grimm 3160 So. Dak. 12
Alsike clover	Trifolium hybridum	3170 Arizona common
Bearded wheatgrass	Agropyron subsecundum	3228 Washington common 3146 1806
Beardless wheatgrass	Agropyron inerme	2617 2792 3537 Whitmar
Beardless wild-rye	Elymus triticoides	2599
Big bluegrass	Poa ampla	3393 2579 2716 Sherman
Big squirreltail	Sitanion jubatum	3360
Bighead clover	Trifolium macrocephalum	4474
Black medic	Medicago lupulina	3141
Bluebunch wheatgrass	Agropyron spicatum	2719 2615
Blue wild-rye	Elymus glaucus	2586
Bulbous bluegrass	Poa bulbosa	2788
Canada bluegrass	Poa compressa	3169
Canada wild-rye	Elymus canadensis	2623
Canby bluegrass	Poa canbyi	3201
Chewings fescue	Festuca rubra commutata	3150 3361
Crested wheatgrass	Agropyron cristatum	3137
Giant wild-rye	Elymus condensatus	3171 Fairway
Green needlegrass	Stipa viridula	3335
Hairyscale Colorado wild-rye	Elymus ambiguus strigosus	3085 3217

Table 5. Continued

Common Name	Scientific Name	Accession Number and Variety
Idaho fescue	<i>Festuca idahoensis</i>	P- 2580
Indian ricegrass	<i>Oryzopsis hymenoides</i>	2717 2373 2683
Intermediate wheatgrass	<i>Agropyron intermedium</i>	2327
Lemmon needlegrass	<i>Stipa lemmoni</i>	4707
Letterman needlegrass	<i>Stipa lettermani</i>	2738
Meadow barley	<i>Hordeum nodosum</i>	2603
Meadow fescue	<i>Festuca elatior</i>	3144 3161
Mountain bromegrass	<i>Bromus marginatus</i>	2133 3368 <i>Bromar</i>
Needleandthread	<i>Stipa comata</i>	3972 3084 3356
Nevada bluegrass	<i>Poa nevadensis</i>	2579
Orchardgrass	<i>Dactylis glomerata</i>	2646 2754 3135
Pea, field	<i>Pisum arvense</i>	3061 Austrian winter
		3136 Alaska field 3168 Canadian field 3175 Kaiser field 3227 O'Rourke field
Perennial ryegrass	<i>Lolium perenne</i>	3162
Pine bluegrass	<i>Poa scabrella</i>	2588
Prairie junegrass	<i>Koeleria cristata</i>	2648 3078
Pubescent wheatgrass	<i>Agropyron trichophorum</i>	41
Red clover	<i>Trifolium pratense</i>	3165
Reed canarygrass	<i>Phalaris arundinacea</i>	2368 Superior 3140
Rye hybrid	<i>Secale cereale</i> X <i>Secale montanum</i>	4560 5701
Sainfoin	<i>Onobrychis sativa</i>	2808
Sand dropseed	<i>Sporobolus cryptandrus</i>	2746

